



## **AIR FORCE CYBERWORX REPORT 17-003**

### **Air Force Cyber Outreach**



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***DESIGN SPRINT CONDUCTED***  
***18 – 20 July 2017 (Sprint)***

*Produced with input from military units including SAF/CIO A6, 10 CS, 24 AF; valuable regional academic partners Pikes Peak Community College (PPCC), Red Rocks Community College (RRCC), and the University of Colorado-Colorado Springs (UCCS); and our valuable partners in industry.*

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## Introduction to AF CyberWorx

CyberWorx is a dynamic organization partnering Airmen, industry, and academia to reimagine how technology might enrich and protect our nation, businesses, and lives. As a human-centric design center, we seek out unique ways to connect Air Force warfighters with current and future technology in meaningful ways. We look to transfer, license, and share promising prototypes, solutions, and knowledge with our partners to create value for both the warfighter and the economy as this is the best way toward operational advantage.

## Design Thinking @AFCyberWorx

Design thinking is a common sense, human-centric problem solving method embraced by innovation leaders in industry, but often overlooked in the government sector. The CyberWorx design thinking process is a transdisciplinary method that breaks down silos of standard organizational structures. Organizations naturally form structures based on specializations to facilitate deep expertise, but these structures often impede creativity, collaboration, and knowledge sharing vital to innovation. CyberWorx deliberately reaches across specialties to bring diverse perspectives to a problem in a non-threatening environment. This evokes ideas that would otherwise be missed or stifled. The transdisciplinary design approach teases out meaningful solutions that are intuitive and desirable to Airmen.

Air Force CyberWorx offers facilitated design thinking sessions that bring stakeholders, industry and academic experts together to develop solutions to hard problems. These sessions are tailored to best meet AF needs with differing lengths based on time sensitivity and CyberWorx capacity. One method, which maximizes solution agility and the educational benefit to warfighters and industry partners, is to offer a design sprint where the week-long design project answers a challenge being worked for AF stakeholders. The goal of such a design sprint is to develop low fidelity prototypes that clearly convey the desired Airman experience and the technical and policy developments needed to bring that experience to fruition. These projects help refine the requirement by seeking the right problem to solve and finding meaningful, forward-looking solutions by exploring a wide range of possible answers to the design problem.

For the Air Force Cyber Outreach Design Sprint, CyberWorx brought together 21 participants from Air Force units, academia, non- and for-profit industry, to rethink how the Air Force Academy and Pikes Peak Community College can interest middle and high school students in pursuing cyber-related careers.



The CyberWorx design thinking approach deliberately breaks through the military's hierarchical and mission silos to find hard-hitting answers.

## Participants

The design sprint was attended by “outsiders” from academia, nonprofit and for-profit industry whose differing perspectives provided unique value distinct from the military members and government civilians attending the sprint. Attendees also had varying levels of experience and expertise in cybersecurity and the middle and high school student populations, providing fresh and diverse opinions on the place cybersecurity has for younger students. The CyberWorx design thinking approach deliberately breaks through the military’s hierarchical and mission silos to find hard-hitting answers.

Participants included staff and faculty from regional elementary and high schools, Pikes Peak Community College (PPCC), Red Rocks Community College (RRCC), the University of Colorado-Colorado Springs (UCCS) and the US Air Force Academy (USAFA) in addition to representatives from nonprofits and industries in need of cyber professionals. This collection of unique backgrounds and perspectives opened the aperture of the realm of what’s possible as CyberWorx tackled the challenge of interesting students into cyber professions.



## Background

The geopolitical climate of today’s culture has evolved rapidly. With the increased threat of cyber terrorism, fake news and the influence of social media that spans across generations, gender and nationality, the need for cyber professionals is ever-increasing. Whether an individual is a digital native seeking a first-time career path or an experienced worker seeking re-training in the cyber field, it is essential that an educational path be available for them to succeed. There are a variety of options available for a student to enter the cyber field, but it is essential that institutions work together to offer the greatest array of opportunities and generate interest as early in academic careers as possible.

The Air Force, Department of Defense and US Government in general are falling behind in the cyber race for talent. Recruiting and retaining cyber professionals is a challenge for both military and industry and is essential to success. To help alleviate the problem, CyberWorx and the US Air Force Academy teamed with other institutions on the Front Range to begin the process of building a pipeline of well-educated cyber professionals capable of meeting demand at a variety of levels and abilities.

## Design Problem Statement: #AFCyberOutreach

As with most CyberWorx sprints and design projects, the best starting point is to identify a relatively small use case that might lead toward fast solutions with the promise of potential scalability. For this sprint, we chose to **identify how USAFA and PPCC might increase middle and high school student participation in classes and clubs aligned with pursuing a cyber career. This may involve strengthening existing STEM outreach programs, modifying existing or creating new programs, partnering differently, etc. (Short name: #AFCyberOutreach)**

**OBJECTIVES:** Push the envelope and come up with creative options for USAFA and PPCC, in partnership with other institutions and companies, to encourage middle and high schoolers to become interested in and stay engaged in academic programs and extracurricular activities which will attract and retain them in cyber career fields/coursework. Deliverable:

Identify specific approaches and methods whereby post-secondary academic institutions can work with middle and high school students to increase the pipeline of cyber professionals whether they go directly into cyber career fields or into cyber academic programs.

**VALUE PROPOSITION:** Design will focus on improving the student experience and generating proofs of concept for making cyber programs more accessible and enticing to middle and high schoolers in the Front Range area, thus increasing the portfolio of potential cyber experts for the Air Force and others. If this is successful in the Colorado Springs area, these prototypes can be replicated beyond the local area.

## Theme Development

Over the course of the 3-day sprint, participants discussed, assessed, brainstormed, and refined ideas of how to interest students into cyber-related classes and programs. The 21 participants were split into four teams, each encompassing diverse backgrounds.

**SOLVING THE PROBLEM:** In exploring the problem base, participants were taken through a process of determining –

- What does “cyber” connote to different groups of individuals?
- What barriers exist in developing interest and motivation in cyber?
- What could be done to overcome the barriers in order to *attract, prepare and retain* cyber professionals?

Each of the four teams was then asked to develop themes based on the above and create and act out a story to illustrate the successful evolution of a program to *attract, prepare and retain* cyber professionals.



## Design Themes and Personas

Progressing through the design process requires teams to analyze and organize information in a manner that communicates efficiently with stakeholders. This communication is aided by the development of Personas - archetypal descriptions of user behavior patterns into representative profiles, to humanize the design focus and test scenarios. The following stories illustrate the teams' design focus.

### TEAM CYBERWORX

Today – Kiana, a young high school teacher in an underserved school has talked with her students and they are interested in starting a coding club but soon found out there are no available computers for

such a use. Undaunted, she heads off to find the principal and explain her needs. When she approaches the principal, however, she discovers he has no money available to allocate to the purchases and is just as frustrated as she is that they can't meet student needs.

Meanwhile, Bill, who works for CyberMoney, an organization that provides educational grants, is exasperated that he has money available, but hasn't heard from anyone asking for a grant that matches CyberMoney's criteria. CyberMoney's purpose is to help provide STEM opportunities to K-12 schools and their criteria aren't all that stringent and yet he has available funds and no applicants. On top of that, his boss has been riding him about getting the funds distributed or the amount will be reduced next year since no one seems to need it. Bill knows there are schools that could really use the help, but doesn't know how to reach them.

Future – Kiana's coding club is up and running thanks to a CyberMoney grant. Kiana knows it is because of the joint USAFA-PPCC led CASH (Cyber Acquisition Supplemental Help) program which was established a few years ago as a pilot program in the Front Range region that they were able to find CyberMoney and successfully complete the application form. CASH's database of grant-providing organizations and their grant criterion pointed Kiana in the right direction and the 1-day workshop with follow-on help for actually completing the application enabled her to zip through the process. Bill, at CyberMoney, was able to distribute all the organization's grant money to needy organizations and thanks to CASH he was able to choose from numerous compelling organizations vying for the grant money. In fact, when he showed his supervisors the depth and breadth of the well-articulated needs, they talked about upping his available funds next year as they know the benefits of increased cyber talent for the Front Range as well as he does. Meanwhile, PPCC has seen an uptick in the number of applicants coming out of Kiana's school with in-depth coding skills and is able to build upon those skills as opposed to starting at a more basic level and the feedback from industry on the skill levels of the PPCC cyber graduates has been amazing. For its part, USAFA has led the way in helping match schools and grants and is viewed as a key Front Range partner in "upping the game" of cyber talent in the area. As an added bonus, many of the grant recipients have gained even more exposure to the Air Force Academy and the Air Force mission.



Way forward: An initial inexpensive prototype of a week-long series of workshops to teach educators how to find and obtain grant funding, particularly "micro grants" of \$1,000 or less, could be funded and organized by PPCC and USAFA. Grant writers and other volunteers could be utilized to speak at the workshops. Funders are an essential part of the process as well, providing immediate feedback to educators on their proposals and implementation plans.



## TEAM CYBERDYNE

Madeline, a young college student at the community college, is making her weekly drive to an elementary school in Colorado Springs and thinking about how excited she is to be a mentor in the new CyberCats program that the US Air Force Academy (USAFA) and Pikes Peak Community College (PPCC) initiated in Colorado Springs a couple years ago. She remembers how lonely she felt in middle and high school as a girl interested in cyber and other tech fields who couldn't find any outlets for her passion. Her first introduction to cyber was thwarted by stigma and gender roles when she idolized a unique character in a game she played in elementary school. The character was an effective hacker with what seemed at the time, to have super powers. Though her father believed she could become like that character and supported her in this dream, she was discouraged from it by classmates and educators who said only males could enter and succeed in such a field. Back then, all the cyber programs were "for the guys" and while she may not have been specifically forbidden to join the groups, it certainly wasn't encouraged or comfortable for her to be there. It was not until college that she realized she really could become a cyber professional.



The USAFA-PPCC CyberCats program was certainly addressing that and Madeline was proud to be in vanguard of making a difference for young girls in the Colorado Springs area. A weekly after-school club for girls K-5, CyberCats was built around a high social interaction foundation that uses game theory. Girls work together to solve problems and move along progressively to a common goal, such as an "escape room," to build cyber skills and confidence. This social experience allows the participants to build confidence at a crucial time in life, when they are trying to figure out who they are and how they fit into the various social groups and hierarchies. The club was even designed to lead into existing programs like Cyber Patriot as an early exposure to the cyber field.

As she pulled into the elementary school parking lot, she noticed her friend and co-mentor, Kesha, pulling up at the same time. Kesha is in her junior year at the Air Force Academy and is the other half of their mentoring "dynamic duo." Due to her Academy schedule, Kesha's availability is a bit more limited than Madeline's, but Madeline knows the girls really benefit from Kesha's perspective. After all, how else would girls in Colorado Springs be able to hear firsthand what it was like to be a girl interested in cyber growing up in Nigeria! The USAFA-PPCC partnership is truly what powers the success of CyberCats!

Way forward: The initial prototype could bring together a focus group of elementary school girls and parents to understand the program better and meet the needs of all the stakeholders. From there, A USAFA-PPCC team would design the program and build metrics for its success. Additionally, local industry would be approached to bring them on as partners working together to make CyberCats a reality at one or two Colorado Springs elementary schools. Based on experiences gained from the first

year of operation, metrics could be refined and the program expanded based on feedback from the schools, PPCC, and USAFA.

### TEAM INNOVATIVE INK SLINGERS

Mr. Peterson, a math teacher at Contrails High School in Colorado Springs, sits back in his chair and a smile slowly creeps over his face as he revels in the moment. We did it, he thinks. We really did it. Despite the obstacles, we did it! Contrails had just been announced as the host school for next year's Student Cyber Summit – the annual gathering of Student Cyber Societies (SCS) from around the Springs area and Mr. Peterson was excited (and a bit scared)! Contrails SCS team had pulled together a competitive bid involving a “knock-out” keynote speaker and age-specific breakout sessions guaranteed to wow the elementary, middle and high school students who would be attending. Earning selection as host of next year's summit (the culminating event of the year for the various SCS teams) was a fitting reward for his team's efforts. He knew it would be a lot of work, but with the ever-present support from USAFA and PPCC, he was confident Contrails would not only pull it off but raise the bar even higher for whoever followed them.

Mr. Peterson remembered the “old days” when he'd tried (and failed) to recruit athletes and other students into a cyber club at the high school level but been rebuffed as by then the students had already made their decisions on where to devote their energies (and cyber was not one of those areas). The SCS formed initially at the elementary school level and got the kids interested in and unafraid of cyber before they were deeply engaged in and committed to other activities. By making the society events fun and interesting (and building upon the initial contacts through the Safe and Secure Online program), kids came to view “cyber” as just a part of their life and not something “weird” or “geeky.” As the students progressed, they developed and built upon virtual characters which grew, matured, and “learned” alongside the students themselves. The long-term relationships the students formed through the SCS both within and external to their schools became a connection they looked forward to renewing at the annual summit and other events. Mr. Peterson marveled at how far the program had come and the impact it had made on the entire Colorado Springs area. Hearing a commotion in the hall, Mr. Peterson sat up and got ready to greet and congratulate the team that had pulled together the winning presentation – he knew hosting the summit would be a lot of work, but with the ever-present support from USAFA and PPCC for the SCS, he was confident Contrails would not only pull it off but raise the bar even higher for whichever school followed them.



Way forward: Implementation of this program would begin with the most cost effective and least time-consuming piece – purchasing Safe and Secure Online kits for underserved elementary schools across Colorado Springs. These would be provided and metrics kept, testing the program's effectiveness in increasing awareness and interest in cyber. Based on that interest, a few after school pilot programs of

Student Cyber Societies could be launched for elementary school students, concluding with the initial SCS summit, bringing the members together from across participating schools and forming the initial network of SCS members.

## TEAM ROGUE ONE

Caroline cautiously peers around the tree, scanning for “enemy” sentries and spies the other team’s flag standing upright in the clearing ahead. Success – it appears to be unguarded and within reach. Caroline, normally an introverted 3<sup>rd</sup> grader at Wahoo Elementary, is in the zone – having adopted her “Virtual and Reality” flag hunter mindset (or her “V&R face” as she prefers to call it). With V&R face on, she takes a few cautious steps forward and thinks about the successes she’s already had today while in the Virtual world portion of Camp Cyber Adventure Hero. If she’s as successful now in the “R” world as she was in the “V” world earlier, she’d have real bragging rights when she got home at the end of camp. Who knew a camp for elementary school kids could combine cyber and nature and actually be fun!



Though she hadn’t really thought of herself as much of a “virtual cyber warrior” prior to coming to Camp Cyber Adventure Hero, her week here had changed all that. From the initial cyber challenges the staff had drawn up to interest her and her fellow campers into venturing into the virtual world to the more interesting and exciting opportunities available as they progressed and became more advanced, Caroline’s skill level in the virtual “capture the flag” games had increased steadily – as had her confidence. It helped, of course, that the staffers were really fun and supportive. She was also impressed with their stories and experiences as students at the Air Force Academy and Pikes Peak Community College – it was great to hear there really was life after elementary school!

Caroline hears a twig snap and is pulled back to the “R” world. The camp offered lots of neat opportunities to explore nature and cyber and where they came together – like in the augmented reality glasses they used on a nature hike and she had enjoyed the geo-caching clue search they had done yesterday but her specialty is in capturing flags – both V&R. Looking across the clearing, she sees one of her teammates, Georgia, stomping on sticks and making a racket. “What is she doing? She’s going to draw everyone to her!,” Caroline’s inner voice screams inside her head. Then, she realizes Georgia is doing just that...but on purpose! She’s stomping on sticks to distract the other team just like they used a diversion in the “V” world earlier today to enable teammates to virtually secure the flag. As





the other team converged on Georgia, Caroline took off at a gallop – legs and arms pumping mightily. She grabs the flag and races back to home base – victory assured in both V & R worlds today!

Way Forward: The initial prototype could be in the form of an after school program since children are comfortable in that environment. USAFA and PPCC would develop (or purchase) an on-line ‘capture the flag’ or similar team game for elementary school children where students “capture flags” based on demonstrating knowledge of basic cyber and on-line security. That would then be paired with “capture the flag” or other “real world” games to complement the virtual games. If this pilot proves successful, it could scale up to longer single- or multi-day camps. It would be important to still have to have outdoor atmosphere as well as connectivity of internet for cyber activities. The goal is to teach online security, password security, etc. to young kids to keep them safe before moving to advanced skills. Since it is designed to be interactive and socially engaging, the skills would be better retained and assimilated.

## **Recommendations – Where to Start Small for Big Impacts**

Air Force CyberWorx recommends a phased approach toward implementing the following aspects of these proposals as described below. USAFA and PPCC leadership, along with the solutions owners, will need to decide where to invest and prioritize their efforts based on these recommendations.

## **Team CyberWorx – Grant-writing to leverage national resources**

The biggest impact can be made by shoring up three fronts relative to grants and by initiating a new front.

- 1) Staff and faculty currently involved in grant research/writing at USAFA and PPCC meet in a ½ day facilitated session in October to work on:
  - a. Ways to identify and share information (with each other and local school districts) on available/applicable grants
  - b. How to help school districts identify and/or communicate their needs (PPCC lead)
  - c. Ways to potentially engage industry or other untapped areas for support (both monetary and non-monetary)
- 2) USAFA and PPCC host a “1-day grant-writing workshop” between Jan and Mar 2018 for school district POCs (teachers, administrators, etc.) where the focus would be on practical writing pointers, requirements, etc.

## **Team Cyberdyne – Elementary school Cyber Club focused on girls and social interaction**

- 1) Determine strengths and challenges with existing “Cyber Warrior Princess” program
  - a. USAFA cadets and PPCC students go to elementary schools where the program exists and talk with participants and others on pros/cons and potential improvements
  - b. USAFA & PPCC faculty/staff talk with Cyber Warrior Princess staff on pros/cons and potential improvements

## Team Innovative Ink Slingers – Student Cyber Societies

- 1) Identify a target district and grade (e.g., District 20, 3<sup>rd</sup> grade) and put every student in that target district and grade through the ISC2 Safe and Secure Online (SSO) program
  - a. USAFA and PPCC fund or identify funding source to procure enough SSO kits to ensure everyone in the target district/ grade receives the training
  - b. USAFA and PPCC work with teachers in the target district/grade to ensure they are comfortable with the kits and how to use them (USAFA/PPCC can leverage ISC2 members in the area as an alternative)
- 2) USAFA and PPCC work with CyberPatriot on ways to energize the existing CyberPatriot programs in the middle schools
  - a. Work with local organizations (i.e., AFCEA) with interest in cyber and see if they can identify additional coaches, etc., to lessen load on middle school teachers
  - b. Identify opportunities to tie SSO more closely with CyberPatriot

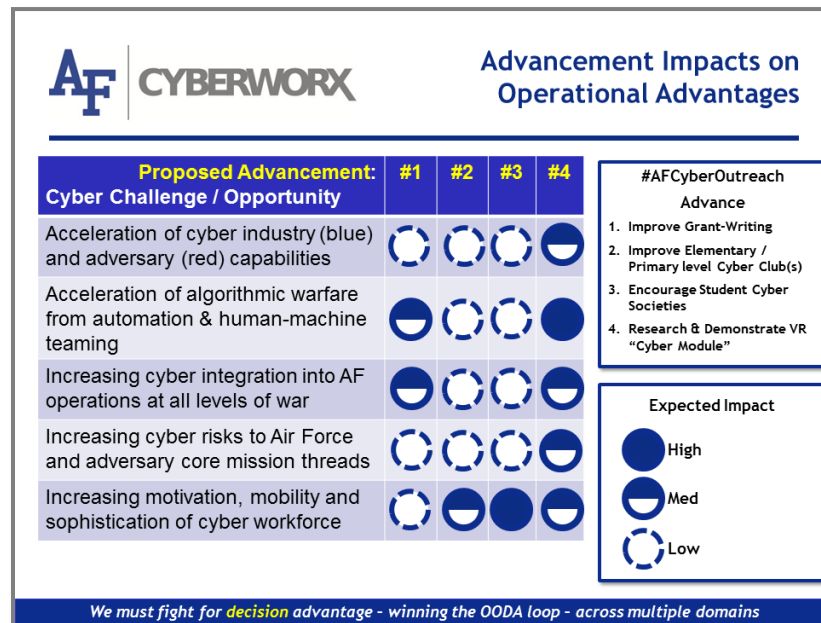
## Team Rogue One – V&R Camp

- 1) USAFA and PPCC create a “cyber module” that can be used by elementary and middle schools during field day activities as part of their rotating schedule
  - a. PPCC to identify schools where this could be inserted into existing activities
  - b. USAFA and PPCC to develop the module and facilitate its use as part of the field day
- 2) USAFA and PPCC to engage their cyber clubs for outreach to elementary and middle schools where the cadets/students tie virtual and real world together experientially
- 3) USAFA host a “cyber day [half day]” for elementary school students with exposure to Cyber City, CyberWorx and a Capture the Flag exercise



### 3-Slide Summary: Ops Advances + The Fast Track

The CyberWorx “three slide summary” section is designed to help you consider the recommendations in this report by weighing the operational improvements proposed against the current cyber challenges and opportunities we face as an Air Force.



In deciding what to do, the decision to do nothing is a decision and brings its own risks. Thus, the “fast track” slide spells out an easy set of actions to take at minimum to start trying to improve and to put the Air Force on a path of discovery in overcoming the challenges that drove this design project.

**AF CYBERWORX** A fast track ahead for #AFCyberOutreach

- USAFA & PPCC facilitated, cyber-focused ½-day grant-writing workshop w/ follow on workshop in early 2018 offered to K-12 educators
- Conduct SWOT analyses of current “Cyber Warrior Princess” program to consider teaming & improvements
- Identify a target local district and grade to achieve 100% participation rate in ISC2’s Safe & Secure Online
  - Assess impact & steps to creation of student relational opportunities, e.g. “Cyber Societies”, to maintain interest/contact
- USAFA & PPCC team w/ AFA CyberPatriot on recruitment and ways to support junior-high participation

*Integrity - Service - Excellence* 3

We recognize we live in a resource-constrained world. Each advance proposed in this report is graphed below. The graph compares the advance’s relative impact on the ability of the Air Force to maintain

information and decision dominance (x-axis) against the difficulty (e.g., expenditure of time/treasure, cultural evolution, policy change) needed to implement that advance (y-axis). Cultural changes, like some of those proposed in this report, are not easy, but they are possible and are needed for success in our digital, cyber-contested world. We don't shy away from advances that are difficult, but tackle them with optimism, a good plan, and as many excellent partners as possible.

